

2016 IR Guidance Recommendation: Hydrologic Alteration Impairments

- I. **Issue:** Accurately Capturing Impairments Due to Hydrologic Alteration in Monitoring and Assessment Decisions and Reporting
- II. **Issue Statement (if existing guidance, the issue statement should touch on why the existing guidance is not sufficient).**

A 2010 study by the U.S. Geological Survey (USGS) found that hydrologic alteration is extensive in the U.S. **Ex. 5 - Deliberative**

The magnitudes of mean annual minimum and maximum stream flow – the dimension most linked to ecological impairment – were altered at 86% of the assessed streams (Carlisle, Wolock, and Meador, 2010). The USGS's 2013 National Water Quality Assessment of stream health, reported that 83% of assessed streams nationwide had at least one altered biological community (algae, macroinvertebrates or fish) and annual high or low stream flows were modified in 86% of the assessed streams (Carlisle, Nelson, & Eng, 2012). Aquatic ecosystems are the most altered ecosystems globally; exhibiting declines in biodiversity that far outpace terrestrial or marine ecosystems (Dudgeon et al. 2006). Climate change is expected to exacerbate the effects of altered hydrology, including those caused by ground and surface water withdrawals, dams and land cover change (Palmer et al. 2009). Despite growing agreement within the scientific community that the impacts of altered hydrology on freshwater ecosystems are extensive, those impacts do not show up as a leading cause of impairment in the state's monitoring and assessment programs under the Clean Water Act and EPA's ATTAINS database. **Ex. 5 - Deliberative**

Ex. 5 - Deliberative Region 4 recommends that the EPA clarify and expand the guidance to encourage states to more fully assess, monitor and report the impacts of hydrologic alteration and thereby improve the opportunities for restoration of these waters.

Ex. 5 - Deliberative the natural flow regime, defined as the characteristic pattern of flow magnitude, timing, duration, frequency, and rate of change, plays a central role in supporting the ecological integrity of streams and rivers and the services they provide (Poff et al. 1997). Human-induced alteration of the natural flow regime can significantly degrade the physical, chemical, and biological properties of a waterbody (Poff et al. 1997; Bunn and Arthington 2002; Annear et al. 2004; Poff and Zimmerman 2010, and many others). An increase in the magnitude, duration and frequency of high flows, such as from peak hydropower or in areas of high impervious cover, can degrade aquatic habitat through scouring and stream bank erosion. Anthropogenically caused low flow conditions, from surface or ground water withdrawals or regulated dams, can reduce water quality, eliminate habitat and concentrate pollutants. Removal of all or most water, such as through bypasses, non-discharging dams or groundwater withdrawals can remove all uses. Flow alteration can result in non-attainment and complete loss of designated uses including aquatic life, recreation, drinking water use or shellfish harvesting.

While existing IR and 305(b) guidance mention flow alteration, it has been primarily been in the context of examples, such as describing those as waters that should be placed in Category 4C. However, those brief references have not resulted in state's accurately capturing the impaired condition of waters. In contrast to the USGS findings, an analysis in Region 4, detailed below, showed that 6 states have just 0-1% of assessed waters listed as impaired by hydrologic alteration, with the other two

states in the 13 – 14% range.

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Ex. 5 - Deliberative Even for those states that do capture these waters, the use of redundant and confusing terms relating to hydrologic alteration in reporting systems and ATTAINS makes it impossible to search for and quantify the number of impairments, determine current levels of impact or create a baseline to measure restoration and prevent further loss of uses.

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In fact, climate change is projected to add to and magnify existing impacts of hydrologic alteration (Palmer et al. 2009). Implementing restoration projects to protect and maintain healthy aquatic ecosystems is a key recommendation within the scientific community for providing resiliency and adaption to climate change. Protection and maintenance of flows may also be critical for supporting communities at the local level as well as supporting state and local economies, as discussed below. Simple clarification and some additional information, detailed below, can provide the guidance needed to allow states to correctly identify and categorize hydrologically altered waters and allow states to get credit for restoration using alternative tools such as placing waters in a ‘restoration’ category such as Region 4’s Category 5R. Clarification and consolidation of terms relating to hydrologic alteration in ATTAINS will allow for easy retrieval and analysis of hydrologically altered waters, assist in identifying streams vulnerable to climate change impacts, and improve the ability to create a baseline for restoration activities needed to mitigate impacts due to climate change or other anthropogenic flow-altering activities.

III. Existing Guidance

i) Guidance referenced

- *2002 Integrated Water Quality Monitoring and Assessment Report Guidance*; November 19, 2001 (“2002 IR Guidance”)
- *Guidance for 2004 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d) and 305(b) of the Clean Water Act*; TMDL-01-03; July 21, 2003 (“2004 IR Guidance”)
- *Guidance for 2006 Assessment, Listing and Reporting Requirements Pursuant to Sections 303(d), 305(b) and 314 of the Clean Water Act*; July 29, 2005 (“2006 IR Guidance”)
- *The Guidelines for Preparation of the Comprehensive State Water Quality Assessments (305(b) Reports) and Electronic Updates: Report Contents* (September 1997) (“305(b) Guidance”)

ii) What the existing guidance states

The IRG states that it is intended to “...report on the water quality standards attainment status of all waters, document the availability of data and information for each water, identify certain trends in water quality conditions, and provide information to managers in setting priorities for future actions to protect and restore the health of our nation’s aquatic resources.” A water is “considered impaired when one or more designated uses are not attained.” Understandably, addressing “water quality standards attainment” and determining impairment has historically focused on the monitoring and assessment of

pollutants or assessing for narrative or numeric criteria.

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However, the EPA noted in 1991 that “water quality standards go well beyond chemical-specific criteria.” (EPA 1991) That is, it is possible to have an impairment of a designated use and/or a downward trend in water quality condition that cannot be determined through the assessment of narrative or numeric criteria or chemical surrogates. This is often the case when determining impairments due to altered hydrology. For instance, in the most extreme example, if all the water is anthropogenically removed from a waterbody where no aquatic life or recreation is possible and field staff cannot take a sample, the guidance does not address how to collect and report that information; yet without water, the designated use is clearly impaired and are arguably completely removed.

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In *PUD No. 1 of Jefferson County v.*

Wash. Dep’t of Ecology, 511 U.S. 700, 718 (1994), the U.S. Supreme Court noted that states have the authority to ensure preservation of the hydrologic conditions necessary to maintain and protect both the existing and the designated uses. In that case, the Court specifically addressed the link between protection of water *quantity* and protection of the *designated use*:

“[A] sufficient lowering of the water quantity in a body of water could destroy all of its designated uses, be it for drinking water, recreation, navigation or...as a fishery.” *PUD* at 719.

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the EPA’s 305(b) guidance (1997) addressed flow modification as a cause of impairment. It defined causes/stressors as “pollutants or other stressors (e.g. flow and habitat alteration, presence of exotic species) that contribute to the action or threatened impairment of designated uses in a waterbody.” Flow alteration was defined as, “frequent changes in flow or chronic reductions in flow that impact aquatic life (e.g. flow-regulated rivers or a stream with excessive irrigation withdrawals).”

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There was no guidance on how to evaluate the use if you could not collect a sample due to either extreme high or low flows.

Flow is mentioned again in the 2004 and 2006 IR Guidance. In the 2004 Guidance, it states,

EPA does not believe that flow, or lack of flow, is a pollutant as defined by CWA Section 502(6). Low flow can be a man-induced condition of a water (i.e., a reduced volume of water) which fits the definition of pollution. Lack of flow sometimes leads to the increase of the concentration of a pollutant (e.g. sediment) in a water. In the situation where a pollutant is present a TMDL, which may consider variations in flow, is required for that pollutant.

However, this reference, again, mostly defines the relationship between pollutants and flow alteration. The 2006 Guidance again mentions flow in Category 4C and states that,

“Examples of circumstances where an impaired segment may be placed in Category 4C include segments impaired solely due to lack of adequate flow or to stream channelization.”

It is important to note that the Agency has clearly acknowledged that flow alteration should be identified and that it should be properly categorized. However, it does not provide states guidance on the current state-of-the-science for understanding the range of ways that flow alteration can impair the

designated use including changes in the magnitude, frequency, duration, or rate of change of flows which cause adverse ecological affects or the pollutants that are now more commonly known to be associated with differing types of flow alteration. The language focuses solely on low flows or physical alteration of channels. This also does not accurately capture the true range of flow impairments, such as high flows from MS4s that cause scouring and impact biological integrity, reservoir releases that completely alter the natural hydrograph, chemical impairments downstream of reservoirs, changes in salinity in estuaries, and many more.

Most importantly, the current guidance has not resulted in states' actually placing waters in 4C for hydrologic alteration.

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The historical derivation of this approach may be found in early EPA guidance. In the *Guidelines for Developing or Revising Water Quality Standards* (January 1973), EPA recommended including a section on stream flows that stated, “The water quality standards shall apply at all times except during periods when flows are less than the average minimum seven-day low flow which occurs once in ten years,” (this is known as the 7Q10 flow). Subsequent iterations of EPA guidance carried this forward, for instance, Section D. 2. of the 2006 IR Guidance, Data Representativeness Considerations, states, “...disregarding valid data during extreme conditions (e.g. significant drought or floods) can be appropriate if applicable state’s WQS include a provision specifying that some or all WQS do not apply during certain rare events, such as a 7Q10 low (or high) stream flow.” Similarly, Sections 4.2.2 of the Consolidated Assessment and Listing Methodology (2002) make similar statements regarding sampling during low flows. The 2002 IR Guidance states that “..the WQS may define critical conditions, such as flow or temperature, under which the criteria apply or should be modified, while the implementation procedures may discuss information like data quality objectives, samples sizes, and SOPs.”

In the 1970’s when EPA drafted those provisions, the concept of utilizing the 7Q10 to represent a low flow condition for worst case scenarios for NPDES permitting or assessment may have been reasonable. Since that time, there has been significant population growth, a historic boom in large and small dam creation, and dramatic increases in power generation, irrigation and surface and ground water withdrawals. The low flows contemplated in the 1970’s may have truly represented a naturally occurring low flow condition that was anticipated to occur no more frequently than once in 10 years. However, anthropogenically caused low flows may now be the regular condition of some of those waters for a duration and frequency far exceeding the ten year recurrence period.

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In fact, a USGS trend analysis demonstrated that the 7Q10 data itself is trending downward in many areas of the country lowering the bar even further. Groundwater withdrawals have increased dramatically and have been shown to have negative effects on water supply and cause reductions in stream flow and spring discharge (Konikow, 2013).

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Finally, the 2006 IR guidance goes even further by explicitly discounting the use of low flow samples for listing purposes, stating, “[o]f course, if the sole sample were collected during a time, condition and/or location condition excluded from application of said WQC, by the state’s WQS regulation, it would not be an appropriate basis for 303(d)-listing a segment. Commonly encountered examples of such exclusions include streamflows below the low-flow 7Q10....”.

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The EPA’s guidance could be updated to clarify and remedy the collection of data and information and explain how to use it to determine if waters are impaired due to hydrologic alteration.

b. Flow impairment reporting

It is unlikely that flow impairments may be adequately addressed or evaluated for restoration if the extent of the impacts do not show up consistently in retrievals. Yet, currently, once a waterbody is assessed as partially or completely impaired due to hydrologic alteration, there is no consistent or defined way of reporting that impairment. In fact, the “Habitat Data” chapter of the 2002 guidance recommends that “moderate to severe habitat alteration by channelization and dredging activities,...bank failure, heavy watershed erosion, or alteration of flow regime” be classified as habitat alteration and impairment. As a result of this, it is common for states to report those impairments as habitat alteration and not hydrologic alteration, especially since it is often identified during habitat assessments. As habitat alteration encompasses more than hydrologic alteration, the extent of hydrologic alteration is unknown. Another example of unclear reporting are impairments reported with a cause of sediment and source of MS4. Here, it is unclear if the source of the impairment is due to an increased load in sediment, an increase in flow quantity causing erosion and sedimentation, or both.

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illustration, Table 2 highlights some of numerous examples from Region 4 of sources that states may associate with flow impairment, and Table 3 includes a list of the causes in Region 4 associated with the Source Group “Hydromodification”:

Table 2: Potential Sources of Flow Alteration in Reported Region 4

Source Group: Hydromodification	
Channel Erosion/Incision from Upstream Hydromodifications	Post-development Erosion and Sedimentation
Channelization	Sediment Re-suspension (Clean Sediment)
Dam or Impoundment	Sediment Re-suspension (Contaminated sediment)
Dredging (E.G. For Navigation Channels)	Stream bank Modifications/Destabilization
Erosion from Derelict Land (Barren Land)	Upstream Impoundments (E.G. PL-566 NRCS Structures)
Impacts from Hydrostructure flow regulation/modification	
Source Group: Agriculture	
Irrigated Crop Production	
Source Group: Natural/Wildlife	
Drought-Related Impacts	Natural Sources
Source Group: Urban-related Runoff/Stormwater	
Discharges from Municipal Separate Storm Sewer Systems (MS4)	Municipal (Urbanized High Density Area)
Highway/Road/Bridge Runoff (Non-construction related)	Unspecified Urban Stormwater
Impervious Surface/Parking Lot runoff	Urban Runoff/Storm Sewers
Industrial/Commercial site Stormwater Discharge (Permitted)	Wet Weather Discharges (Non-Point Source)
Source Group: Other	
Introduction of Non-Native Organisms (Accidental or Intentional)	

Table 3: Causes associated with the Source Group of “Hydromodification” in Region 4

Alteration in Stream-side or Littoral Vegetative Covers	
Aquatic Algae	Odor Threshold Number
Aquatic Plants (Macrophytes)	Organic Enrichment (Sewage) Biological Indicators
Benthic Macroinvertebrates Bioassessments	Other Anthropogenic Substrate Alterations
Biological Impairment	Other Flow Regime Alterations
Carbonaceous BOD	Particle Distribution (Embeddedness)
Cause Unknown	pH
Copper	Phosphorus, Total

Dissolved Oxygen	Physical Substrate Habitat Alterations
Fish Bioassessments	Sedimentation/Siltation
Habitat Assessments (Streams)	Specific Conductivity
Iron	Sulfates
Low Flow Alterations	Sulfide-hydrogen Sulfide
Manganese	Temperature, Water
Nitrate/Nitrite	Total Dissolved Solids (TDS)
Nitrogen, Total	Total Suspended Solids (TSS)
Nitrogenous BOD	Turbidity
Nutrient/Eutrophication Biological Indicators	Zinc

Under the 4C section, the 2004 guidance states that, “Lack of flow sometimes leads to the increase of the concentration of a pollutant (e.g., sediment) in a water. In the situation where a pollutant is present a TMDL, which may consider variations in flow, is required for that pollutant.”

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IV. Proposed Recommendation

Expansion and clarification of existing IR guidance is needed to reflect current conditions and impairments as well as the most up-to-date scientific knowledge. **Ex. 5 - Deliberative**

Ex. 5 - Deliberative Below are proposed recommendations. Additional information on each of these can be readily provided if needed.

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B. **Ex. 5 - Deliberative**

C. **Ex. 5 - Deliberative**

D. **Ex. 5 - Deliberative**

E. Clarify and consolidate the terms used for flow impairment in ATTAINS.

F. Create or clarify fields in STORET to capture data (or lack of) that can be used to make flow assessment decisions. For example, instances where samples were not able to be collected due to low flow and other hydrologic alterations should be captured in STORET.

V. Implications (e.g., environmental benefits, program management)

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